Staff Report

USE INFORMATION AND AIR MONITORING RECOMMENDATION FOR THE PESTICIDE ACTIVE INGREDIENT PERMETHRIN

February 1997

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A. BACKGROUND

This recommendation contains general information regarding the physical-chemical properties and the historical trends in the use of 3-(2,2-Dichloroethenyl)-2,2-dimethylcyclopropane-carboxylic acid (3-phenoxyphenyl) methyl ester (permethrin). The Department of Pesticide Regulation (DPR) provides this information to assist the Air Resources Board (ARB) in their selection of appropriate locations for conducting pesticide air monitoring operations.

Permethrin (CAS: 52645-53-1) exists as either colorless crystals or a light yellow viscous liquid. Technical material contains 60% *trans*- and 40% *cis*- isomers. Permethrin has a molecular formula of $C_{21}H_{20}Cl_2O_3$, a molecular weight of 391.29 g/mole, and a specific density of 0.960 at 25 ºC**.** It has a water solubility of 0.2 mg/L at 20 ºC, a Henry's Constant of 1.0×10^{-5} atm·m³/mol at 20–25 °C, and a vapor pressure of 1.88×10^{-8} mmHg at 20 ºC. Permethrin is miscible with many organic solvents except ethylene glycol.

Soil microorganisms rapidly hydrolyze permethrin to 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylic acid and 3-phenoxybenzyl alcohol. When applied at recommended rates, permethrin's soil half–life ($t_{1/2}$) is less than 38 days in soils containing 1.3 to 51.3 percent organic matter with pH ranging from 4.2-7.7. Permethrin degrades by photolysis in aqueous solutions containing various organic solvents and under UV light, or on soil in sunlight. Permethrin's photolytic decomposition results in the isomerization of the cyclopropane moiety and ester cleavage. The identified photolysis products include 3-phenoxybenzyl-dimethyl acrylate, 3-phenoxybenzaldehyde, 3-phenoxybenzoic acid, monochloro-vinyl acids, *cis*- and *trans*-dichlorovinyl acids, benzoic acid, 3-hydroxybenzoic acid, 3-hydroxybenyl alcohol, benzyl alcohol, benzaldehyde, 3-hydroxybenzaldehyde, and 3-hydroxybenzoic acid.

Permethrin's acute oral LD_{50} is approximately 4,000 mg/kg for rats. Its LC_{50} (48 hour) is 5.4 µg/L for rainbow trout, and 1.8 µg/L for bluegill sunfish. Based on potential reproductive considerations, permethrin entered the risk assessment process at DPR under the SB 950 (Birth Defect Prevention Act of 1984).

B. USE OF PERMETHRIN

As of January 16, 1997, 448 permethrin-containing products were registered for use in California. The currently registered permethrin products include: 1) agricultural products for the control of the larvae, adults, and eggs of chewing lepidopterous and coleopterous insect pests in a variety of crops; 2) flea collars, dips and pet sprays for the control of fleas, ticks and flies on dogs; 3) home and garden sprays

and foggers; and 4) ear tags, powders, and sprays for the control of insects on cattle and other domesticated animals.

With DPR's implementation of full pesticide use reporting in 1990, all users must report the agricultural use of any pesticide to their county agricultural commissioners, who subsequently forward this information to DPR. DPR compiles and publishes the use information in the annual Pesticide Use Report (PUR). Because of California's broad definition for agricultural use, DPR includes data from pesticide applications to parks, golf courses, cemeteries, rangeland, pastures, and along roadways and railroad rights-of-way, postharvest applications of pesticides to agricultural commodities, and all pesticides used in poultry and fish production, and some livestock applications in the PUR. DPR does not collect use information for home and garden use, or for most industrial and institutional uses. The information included in this monitoring recommendation reflects widespread field applications of permethrin. Use rates were calculated by dividing the total pounds of permetrin used (where permetrin was applied to acreage) by the total number of acres treated.

Permethrin is a widely-used, non-systemic insecticide with contact and stomach action, and has a slight repellent effect. In California's agricultural setting, growers use permethrin primarily to control the larvae, adults, and eggs of chewing lepidopterous and coleopterous insect pests in a variety of crops. Additionally, users apply permethrin as a residual surface spray in mushroom houses, and livestock and poultry quarters. According to product labels, permethrin's recommended use rates range from 0.05 to 0.5 pounds of active ingredient per acre. Permethrin is formulated as either an emulsifiable concentrate, wettable powder, dustable powder, aerosol, or as granules. Permethrin-containing products include the Signal Word "Warning" on their labels. DPR registers permethrin as a restricted-use pesticide because of its toxicity to fish and aquatic organisms.

According to the PUR, nearly 80 percent of California's agricultural permethrin use occurs in ten counties (Table 1). Historically, agricultural applications account for approximately 99 percent of the total amount of permethrin reported used each year. Non-agricultural applications—landscape maintenance, structural pest control, or rights-of-way—account for less than one percent of the reported annual use.

Table 1. Annual Agricultural Use of Permethrin (Pounds of Active Ingredient)

County	1995	1994	1993
Monterey	48,191	42,103	41,133
Imperial	26,228	34,113	49,074
Ventura	10,445	6,212	26,997
Fresno	10,018	7,045	9,235
Madera	9,507	6,547	3,800
Santa Barbara	7,732	5,674	6,531
Stanislaus	6,569	8,339	5,626
Kern	5,644	7,193	6,972
Merced	4,898	4,777	4,902
Sutter	4,576	5,170	4,286
County Totals	133,808	127,173	158,556
Percent of Total	***78%***	***74%***	***78%***
CALIFORNIA TOTAL	**170,741**	**171,317**	**202,425**

In general, Monterey County reports the greatest field use of permethrin according to the PUR (Table 1). In Monterey County, the agricultural use of permethrin during September generally trended upward from 1993 to 1995; in 1995, the highest reported use in a month occurred in Monterey County in September. With the exception of 1992, agricultural applications of permethrin in Monterey County are consistently highest in September followed by August (Table 2).

Table 2. Agricultural Applications of Permethrin in Monterey County

	1995		1994		1993	
	Lbs Used[1]	*Rate*[2]	*Lbs Used*[1]	*Rate*[2]	*Lbs Used*[1]	*Rate*[2]
Monterey						
September	8,381	0.14	7,165	0.14	7,487	0.14
August	7,888	0.14	5,063	0.13	6,162	0.13

[1] In pounds of active ingredient.

[2] Average rate (in pounds of active ingredient per acre).

In an agricultural setting, growers use permethrin primarily to control chewing lepidopterous and coleopterous insect pests. They use permethrin to control the navel orange worm in almonds, peaches, pistachios, and walnuts. Growers apply permethrin to control ants in almonds and pistachios, oriental fruit moth in almonds and peaches, peach twig borer in almonds, peaches and pistachios, and coddling moth in walnuts. Additionally, they use permethrin to control lygus bugs, earworms, cutworms, and other pests. Table 3 shows the average monthly rates of reported permethrin use on the crops with the consistently highest rates of use.

Table 3. Average Monthly Rates of Permethrin Use in Three Counties on Crops with the Consistently Highest Rates of Use.

County	Month	Crop	Average Rate[1]
Butte	May	Walnuts	0.31-0.36
Madera	April-May	Pistachios	0.23-0.28
Butte	June, July, August	Peaches	0.25-0.47
Kern	April	Pistachios	0.24-0.43

[1] In pounds active ingredient per acre.

C. RECOMMENDATIONS

1. Ambient Air Monitoring

The historical trends in permethrin use suggest that monitoring should occur over a 30- to 45-day sampling period in Monterey County from late August through the end of September. Three to five sampling sites should be selected in relatively high-population areas or in areas frequented by people. Sampling sites should be located near lettuce and celery growing areas. Ambient samples should not be collected from samplers immediately adjacent to fields or orchards where permethrin is being applied. At each site, twenty to thirty discrete 24-hour samples should be taken during the sampling period. Background samples should be collected in an area distant to permethrin applications.

Replicate (collocated) samples are needed for five dates at each sampling location. Two collocated samplers (in addition to the primary sampler) should be run on those days. The date chosen for replicate samples should be distributed over the entire sampling period. They may, but need not be, the same

dates at every site. Field blank and spike samples should be collected at the same environmental conditions (e.g., temperature, humidity, exposure to sunlight) and experimental conditions (e.g., air flow rates) as those occurring at the time of ambient sampling.

2. Application-Site Air Monitoring

The historical trends in permethrin use (Table 3) suggest that application-site air monitoring should be conducted during one of four periods during the year, when application rates are at their highest. Monitoring may be conducted in either: 1) Butte County during May associated with applications to walnuts; 2) Butte County during June, July, or August associated with applications to peaches; 3) Madera County in April or May in association with application to pistachios; or 4) Kern County in April associated with application to pistachios. In any case, monitoring should be related to applications at the highest rates of 0.30 pounds permethrin per acre or greater. Permethrin is extensively applied during these periods so care should be taken so that nearby applications do not contaminate collected samples. A three day monitoring period should be established with sampling times as follows: application + 1 hour, followed by one 2-hour sample, one 4-hour sample, two 8-hour samples and two 24-hour samples. A minimum of four samplers should be positioned, one on each side of the field. A fifth sampler should be collocated at one position. Since permethrin is extensively used in the area, background samples should collect enough volume (either 12 hours at 15 liters/min, or a shorter period with a higher volume pump) to permit a reasonable minimum detection level. Ideally, samplers should be placed a minimum of 20 meters from the field. Field blank and field spike samples should be collected at the same environmental (temperature humidity, exposure to sunlight) and experimental (similar air flow rates) conditions as those occurring at the time of sampling.

Additionally, we request that you provide in the monitoring report: 1) an accurate record of the positions of the monitoring equipment with respect to the field, including the exact distance that the sampler is positioned from the field; 2) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, buildings, and other obstacles; 3) meteorological data collected at a minimum of 15-minute intervals including wind speed and direction, humidity, air temperature, and comments regarding degree of cloud cover; and 4) the elevation of each sampling station with respect to the field, and the orientation of the field with respect to North (identified as either true or magnetic North).